

SHEET FEEDER

BACKGROUND OF THE INVENTION

[0001]

The present invention relates to a sheet feeder for holding a plurality of paper sheets and feeding individual sheets one by one to an image reading device, printer or the like. Specifically, it relates to a sheet feeder provided with a sheet sensor for detecting the absence/existence of a sheet and the width of a sheet by sensing a change of a swing angle of a sensor lever.

[0002]

Particularly in image reading devices or printers, separating a paper sheet from a pile of sheets loaded in a sheet feeding portion and feeding it to a next process is a very important technique which therefore has been implemented by using a various well-known structures and arrangements of printers etc..

[0003]

There are various kinds of methods for separating a paper sheet from a plurality of sheets, e.g., by using a combination of a feeding roller and a reverse rotating roller or a combination of a feeding roller and a separating nail or a combination of a feeding roller and a separating plate or vacuum suckers.

A method using a rotary (swinging) lever for discriminating the size of a paper sheet and the existence/absence of a paper sheet is also known. Specifically, this conventional method has been implemented in such a manner that the swinging lever can take refuge in an opening made on a sheet supporting table to widen the swinging range of the swinging lever in order to increase the detection ability of the swinging lever.

[0004]

In recent years, there has been seen the tendency of miniaturization of image forming apparatuses such as image reading devices and printers which in turn have a tendency that a number of loaded paper sheets increases, then the capability of loading a larger number of paper sheets in a smaller space becomes an important designing element ensuring separation and transportation of an individual paper sheet. Consequently, saving in the physical space for mounting a sheet sensor has become an important problem to be solved.

SUMMARY OF THE INVENTION

[0005]

An object of the present invention is to provide a sheet feeder capable of causing a conventional sensor lever to swing in accordance with an amount of sheets loaded in a sheet cassette and detecting the amount of the sheets based on a change in a swing angle of the sensor lever, wherein a bottom

board for supporting a pile of sheets has a notch for receiving the sensor lever so that the sensor lever can surely detect the existence/absence of the paper by increasing a changing amount of the swing angle of the sensor lever before and after the last sheet is fed. In this instance, it is difficult to achieve a sufficient sheet holding capacity since the maximum amount of sheets loaded on the bottom board may be restricted by a distance between a surface of the bottom board and the supporting axis of the sensor lever.

Therefore, the sheet feeder according to the present invention can load an increased amount of sheets by enabling the sensor lever to swing for loading a larger number of sheets in the sheet cassette and, when an amount of sheets increases, retracting the sensor lever from the pile of sheets. On the contrary, with a small amount of remaining sheets, the sensor lever is prevented from retracting never to fail in detecting the state of no remaining sheet in the sheet cassette.

[0006]

Another object of the present invention is to provide a sheet feeder separating a sheet from a pile of sheets loaded in a sheet cassette and feeding it to a next process, wherein a sensor lever abuts against a top of a pile of sheets in the sheet cassette and swings with a swinging axis and changes its angle in accordance with an amount of sheets loaded in the sheet cassette, and when a large number of sheets are loaded in the sheet cassette the swinging axis can move upward together with

the sensor lever in the direction of separating the sensor lever from the pile of sheets. This makes it possible to increase the maximum number of sheets to be loaded by using space efficiently when designing a compact image reading device or printer which needs to ensure separation and transportation of a sheet.

[0007]

Another object of the present invention is to provide a sheet feeder as described above, wherein a sensor lever is supported at its swinging axis in an elliptic hole made in a supporting member and has an abutting member which may abut against the receiving portion of the supporting member to prevent the swinging axis of the sensor lever from moving with a small amount or no amount of sheets. This simple means enables the sheet feeder to surely prevent the movement of the swinging axis of the sensor lever, ensuring the reliable operation of the sensor lever with a small amount of remaining sheets to be fed.

[0008]

A further object of the present invention is to provide a sheet feeder as described above, wherein a sensor lever is supported at its swinging axis with a noncircular cross-section inserted in an elliptic hole with an enlarged round portion made in the supporting member to prevent the movement of the swinging axis in the elliptic hole of the supporting member with a small amount or no amount of sheets, thereby ensuring

the reliable operation of the sensor lever with a small amount of remaining sheets in the cassettes.

[0009]

A still further object of the present invention is to provide a sheet feeder as described above, wherein a lower tip of the sensor lever can fall into a concave formed in a sheet piling portion to increase the rotation angle of the sensor lever before and after the last sheet is fed, thereby ensuring the reliable detection of the existence/absence of the sheets.

BRIEF DESCRIPTION OF DRAWINGS

[0010]

Fig. 1 is a schematic sectional view of a laser facsimile apparatus using a sheet feeder according to the present invention.

Fig. 2 is a perspective view of a sheet cassette used in the laser facsimile apparatus.

Figs. 3A, 3B and 3C are sectional side views for explaining the operation of the sheet cassette.

Fig. 4 is a side view of the first example of a sheet sensor used in a sheet feeder according to the present invention.

Fig. 5 is a side view of the second example of a sheet sensor used in a sheet feeder according to the present invention.

PREFERRED EMBODIMENTS OF THE INVENTION

[0011]

A sheet feeder according to the present invention is to separate a sheet from a sheet pile and feed it to a next processing portion and is applied for an image reading device in which document sheets piled are picked up one by one, scanned by a document reading device and then delivered out, or an image forming device, for example, a printer wherein cut-sheets are picked up one by one, printed by a printing portion and then delivered out. The following example is the case of using a sheet feeder according to the present invention in a laser facsimile apparatus using the Carlson process.

[0012]

Fig. 1 schematically illustrates in cross section a laser facsimile apparatus using a sheet feeder according to the present invention, where electronic circuits etc. which do not directly relate to the present invention are omitted for simplicity. In the laser facsimile apparatus, a control portion 1 is a man-machine interface portion having various kinds of key buttons for inputting information by a user and a display for presenting information to a user.

A plurality of documents to be read are loaded on a document feeding portion 2 and separated one by one by a separating rubber plate 4 disposed opposite to a separator roller 3 and fed to a document reading unit 5 by which it is read and then

delivered by a document delivering rollers 6 to a document discharging portion 7 where a document stacker (not shown in Fig. 1) is provided for receiving documents delivered.

[0013]

A pile of sheets (recording paper) S are loaded in a sheet cassette 11 wherefrom one sheet is separated and fed by a pickup roller 12 (to be described later) to an image transferring portion 19 where toner from a light-sensitive drum 14 is transferred on the sheet S and forms a visible image on the sheet S. The sheet carrying a toner-developed image is then heated by a fixing roller 21 for fusing and fixing toner which forms the image on the sheet S. The sheet S is transported along a document transporting route 20 through the fixing roller 21 to a delivery stacker 22. For simplicity, some of the sheet guides disposed along the document transporting route 20 for transporting a sheet S are not shown in Fig. 1.

[0014]

Printing the sheet S is carried out as follows:

Laser beam L from a laser unit 16 transfers image on the light-sensitive drum 14 previously electrically charged by a charging portion 15. Laser beam L is modulated with information to be printed and converted by a polygon mirror (not shown) to a scanning beam which beam is then reflected from a reflecting mirror 17 and scan the electrically charged surface of the light-sensitive drum 14 to form a latent electrostatic image thereon to be transferred later on a recording paper sheet.

Namely, the scanning laser beam L carries thereon an on-off imaging pattern necessary for forming an image to be printed and the drum electrically charged in advance by the charging portion 15 is scanned by the laser beam L becomes to have decreased potentials of exposed parts on its surface in accordance with the scanning pattern, resulting in forming a latent electrostatic image to be printed on the light-sensitive drum 14. The latent electrostatic image formed on the light-sensitive drum 14 is developed with toner picked up from a developing bath 18 to present a visible image which is then transferred onto a sheet S by an image transfer portion 19. A sensor lever according to the present invention is applied as a sheet sensor for a pile of sheets S loaded in a sheet cassette 11 of the shown laser facsimile apparatus.

[0015]

Fig. 2 is a perspective view of a sheet cassette used in a laser facsimile apparatus. Sheets are piled on a bottom board 23 of the sheet cassette 11, which board is supported at one end by a supporting shaft 25 and can be lifted by a force of a spring 26 (see Figs. 3A, 3B and 3C). The front edge of the top of the sheet pile is prevented from being lifted by a pair of sheet limiting fingers 27. Namely, the top of the sheet pile is always pressed by the sheet limiting fingers 27. When a pickup roller 12 starts rotation and pushes the top sheet by the friction force produced there between, then only the top sheet is fed forward (to right in Fig. 2) overcoming the

preventing force of the sheet limiting fingers 27. Namely, owing to the fact that a friction force produced between the pickup roller 12 and a top sheet is greater than a total of a preventive force of the sheet limiting fingers 27 and a friction force produced between a top sheet and the next sheet, only the top sheet can be separated and fed from the cassette to a next process.

[0016]

When the last sheet S was fed from the sheet cassette 11 shown in Fig. 2, i.e., no paper exist on the bottom board 23 of the sheet cassette 11, a (front) lower tip 34a of a sensor lever 34 falls into a concave (i.e., "sensor lever receiving port") 24 formed on the bottom board 23 with a large change in swing angle, which is detected to indicate the absence of the sheet S in the sheet cassette 11. The provision of the sensor lever receiving port 24 can produce a greater change in swing angle of the sensor lever 34 before and after the last sheet S disappears from the sheet cassette 11, thereby making it possible to surely detect the state of no paper existing in the sheet cassette 11. A change in a swing angle of the sensor lever 34 can be detected by using a suitable sensor element such as a micro-switch, reed switch, electromagnetic sensor, photo coupler and so on. A linear arrangement of plural micro-switches for detecting an angle of the sensor lever 34 is effective to indicate an approximate amount of recording sheets remaining in the sheet cassette 11.

[0017]

Figs. 3A, 3B and 3C are sectional side elevations for explaining the operation of the sheet cassette. Fig. 3A shows the sheet cassette loaded with a sufficient amount of sheets, Fig. 3B shows the sheet cassette with a small amount of sheets therein and Fig. 3C shows the sheet cassette with no paper therein.

In Fig. 3A, the sheet cassette 11 is full loaded with paper sheets S on the top of which a sensor lever 34 lies taking an approximate horizontal angular position. In this state, a whole sensor lever 34 with its swinging axis (sensor lever axis) 35 is lifted upward by the effect of technical means (to be described later) to increase the number of sheets to be loaded in the sheet cassette 11.

[0018]

Fig. 3B illustrates the state of the sheet cassette 11 containing a small amount of paper sheets S in which the bottom board 23 supported by the supporting shaft 25 is tilted with its front end lifted on the side of the pickup roller 12. In this state, the top of paper sheets abuts against the sheet limiting fingers 27 and the function of separating a top sheet and feeding it by the pickup roller 12 still remains in ready to operate. The lower tip 34a of the sensor lever 34 moved downward from the position shown in Fig. 3A. However, a detection signal "no paper" cannot be generated in this state of the sensor lever 34.

[0019]

When the last sheet was fed from the sheet cassette 11, the sensor lever 34 falls into the sensor lever receiving port 24 formed on the bottom board as shown in Fig. 3C. In this state, the lower tip 34a of the sensor lever 34 dropped by a considerable angle, which can be easily detected to indicate the absence of paper in the sheet cassette 11.

[0020]

Fig. 4 illustrates a side view of the first example of a sheet sensor used in the sheet feeder according to the present invention. A sensor lever 34 has a sensor lever axis (swinging axis) 35 fitted in an elliptic hole 32 made in a sensor lever holding member 31 for the sensor lever and can freely swing. A sensor lever holding member 31 corresponds to a supporting member defined in claims. The sensor lever 34 locates at the lowest part of the elliptic hole 32 by its weight. The sensor lever 34 has a sensor lever abutting member 36 and the sensor lever holding member 31 has a sensor lever receiving member 33. With a small amount of sheets in the cassette as shown Fig. 4, the sensor lever 34 swings and the sensor lever abutting member 36 abuts against the sensor lever receiving member 33 of the sensor lever holding member 31. In this state, the sensor lever axis 35 cannot move upward in the elliptic hole 32. As described above, when the number of sheets in the sheet cassette is small, the sensor lever axis 35 is prevented from moving upward in the elliptic hole 32 by abutting the sensor lever

abutting member 36 against the sensor lever receiving member 33. A change in angular position of the sensor lever 34 is correctly detected to indicate the existence/absence of a paper sheet in the cassette.

[0021]

Fig. 5 illustrates a side view of the second example of a sheet sensor usable in a sheet feeder according to the present invention.

The sensor lever 43 has a sensor lever axis 44 movably fitted in an elliptic hole 42 made in a sensor lever holding member 41 for the sensor lever. The sensor lever axis 44 has a noncircular section of different sizes in radial directions. In the shown instance, the sensor lever axis 44 with an elliptic cross-section can or cannot move in the elliptic hole in the holding member depending on an angle of the sensor lever 43. On the other hand, the elliptic hole 42 made in the holding member 41 has a larger diameter round hole 42a in its lower end of the elliptic hole 42. Therefore, the sensor lever axis 44 can freely rotate in the larger round hole 42a at any angle of the sensor lever 43. When the sensor lever 43 takes a near horizontal position in Fig. 5, the sensor lever axis 44 can move upward in the upper portion of the elliptic hole 42 since the direction of the longest diameter of the sensor lever axis 44 is identical to the longitudinal direction of the elliptic hole 42 of the sensor lever holding member 41.

This sheet sensor can retract the sensor lever 43 upward

by moving the sensor lever axis upward in the elliptic hole 42 when the sheet cassette is loaded with a large number of paper sheets. On the other hand, the sheet sensor keeps the sensor lever axis 44 in the large round hole 42a when the sensor lever 43 works with a reduced amount of sheets in the sheet cassette, reliably sensing the existence/absence of paper sheets to be fed.

[0022]

While the present invention has been described by way of examples with the case that a sheet cassette is provided with a sheet sensor for sensing the existence/absence of paper sheets and an approximate amount of sheets remaining in the sheet cassette, it is also possible to discriminate the sizes of paper sheets to be used by arranging a plurality of sensors in width direction of the sheet cassette in accordance with different format sizes of paper sheets to be accommodated therein.

While the invention has been described with the application of the sheet feeder to a facsimile apparatus, image reading device, and printer, the sheet feeder can be also applied to any of other devices requiring feeding paper sheets from a pile of sheets and, therefore, the scope of the claims is not limited to the described applications and embodiments.

[0023]

A sheet feeder according to the present invention is a compact structure and capable of accommodating a large number

of paper sheets in the sheet cassette by swinging the sensor lever and retracting the sensor lever upward with its swinging axis moved in the direction parting from the top of sheets when a large amount of sheets are loaded in the sheet cassette, and making the movement of sensor lever reliable which detects the existence/absence of a paper sheet by the sensor lever.

With a small amount or no amount of sheets remaining in the sheet cassette, the abutting member is formed on the sensor lever and abuts against a receiving member of the supporting member, thereby preventing the movement of the swinging axis in a simple structure and enabling the movement of the sensor lever to be reliable.

The sensor lever has a swinging axis of a noncircular profile, which axis is fitted in an elliptic hole with an enlarged round hole formed in the supporting member. With a small amount or no amount of paper sheets remaining in the sheet cassette, the swinging axis is kept in the enlarged round hole in order to ensure the reliable action of the sensor lever with decreasing amount of the remaining sheets.

When the last sheet was fed from the sheet cassette, a lower tip of the sensor lever falls into a concave formed in the bottom board of the sheet cassette. This can provide a considerable change in swinging angle of the sensor lever before and after the last sheet is fed, which can be surely detected to indicate whether the last paper remains or not.